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# Mesozoic micropalaeontology of exploration well Elf 55/30–1 from the Fasnet Basin, offshore southwest Ireland

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**ABSTRACT**—The geology, biostratigraphy and palaeoecology of exploration well Elf 55/30–1 in the Fastnet Basin are summarised. The biostratigraphical and ecological distribution of the foraminifera and Ostracoda from the late Triassic, the Lower Jurassic and the Lower Cretaceous are reviewed with reference to microfaunas elsewhere in Europe. Selected microfossil taxa are illustrated.

## INTRODUCTION

This paper presents a biostratigraphical and palaeoecological description of the foraminifera and Ostracoda from part of the late Triassic, the Lower Jurassic and Lower Cretaceous of exploration well Elf 55/30–1. Other studies of the Mesozoic microfaunas within the Celtic Sea area include that of Colin *et al.* (1981), describing the Cretaceous and late Jurassic microfaunas from the Esso-Marathon wells within quadrants 47, 48, 56 and 57; and a study discussing the 12 microfaunal and microfloral associations recognised in the Lower Cretaceous in the Fastnet Basin (Ainsworth *et al.*, 1985).

## GEOLOGY

Elf 55/30–1 was the first of ten wells drilled within the Fastnet Basin, which is situated at the southwestern end of the North Celtic Sea Graben, approximately 140 km south of Ireland (Fig. 1). The fault-bounded basin is elongate, measuring 110 km long and 40 km wide and trends northeast to southwest (Naylor & Shannon, 1982). It was spudded on 18th April 1976 and was plugged and abandoned on 28th June 1976. The well was drilled in 130 m of water and reached a total depth of 2800 m, terminating in Devonian rocks.

The geology of the Fastnet Basin has been described by Robinson *et al.* (1981) and by Naylor & Shannon (1982). Early Triassic continental red beds unconformably overlie the Devonian red beds and tuffs. These sediments are succeeded conformably by the Liassic Limestone sequence characteristic of the Lower Jurassic marine transgression. In the basal part of this limestone unit both littoral and non-marine microfaunas occur, indicating a transgressive/regressive shoreline in this area during the Rhaetian and early Hettangian. A shallow marine environment became established in the late Hettangian and earliest Sinemurian. A marly shale of Sinemurian age overlies this limestone, above which is a Sinemurian sandstone sequence thought to represent a delta front. These sandstones pass into low energy outer-shelf calcareous shales of Sinemurian – Pliensbachian age. The early Toarcian is represented by shallow marine shales with much lignite and gypsum, suggesting a close proximity to land.

A major unconformity occurs between the Cretaceous and the Lower Jurassic which is a result of Cimmerian movements. The lowermost Cretaceous rocks consist of non-marine sandstones and shales, devoid of *in situ* microfaunas, typical of the 'Wealden' facies. These pass into the Barremian marine clays, sandstones and lignites containing moderately abundant marine fossils. This marine incursion continued to deepen until the earliest Albian, where a regressive Greensand phase of Albian to early Cenomanian is initially represented by a marginal marine facies, and later an inner shelf facies. This is followed by the late Cretaceous Chalk marine transgression spanning the Cenomanian to Campanian Stages.

The Tertiary sediments unconformably overlie the Cretaceous and consist of a thick inner shelf limestone succession of Middle Eocene to Oligocene age. This passes into open marine Miocene to Pliocene clays with a topmost unit of arenaceous sediments.

## BIOSTRATIGRAPHY AND PALAEOECOLOGY

One hundred and eleven cuttings samples were examined, 14 from the Lower Cretaceous and lowermost Upper Cretaceous, and 97 from the Lower Jurassic and part of the late Triassic. The samples were taken at either 5 m or 10 m intervals, which in some cases has led to assemblages from different stages becoming mixed, especially in the condensed Lower Cretaceous sequence.

The more important foraminiferal and ostracod taxa from the Lower Cretaceous, the Lower Jurassic and late Triassic are listed below. The first occurrences mentioned represent the topmost occurrence of the microfossil in the well (Figs. 2, 3).

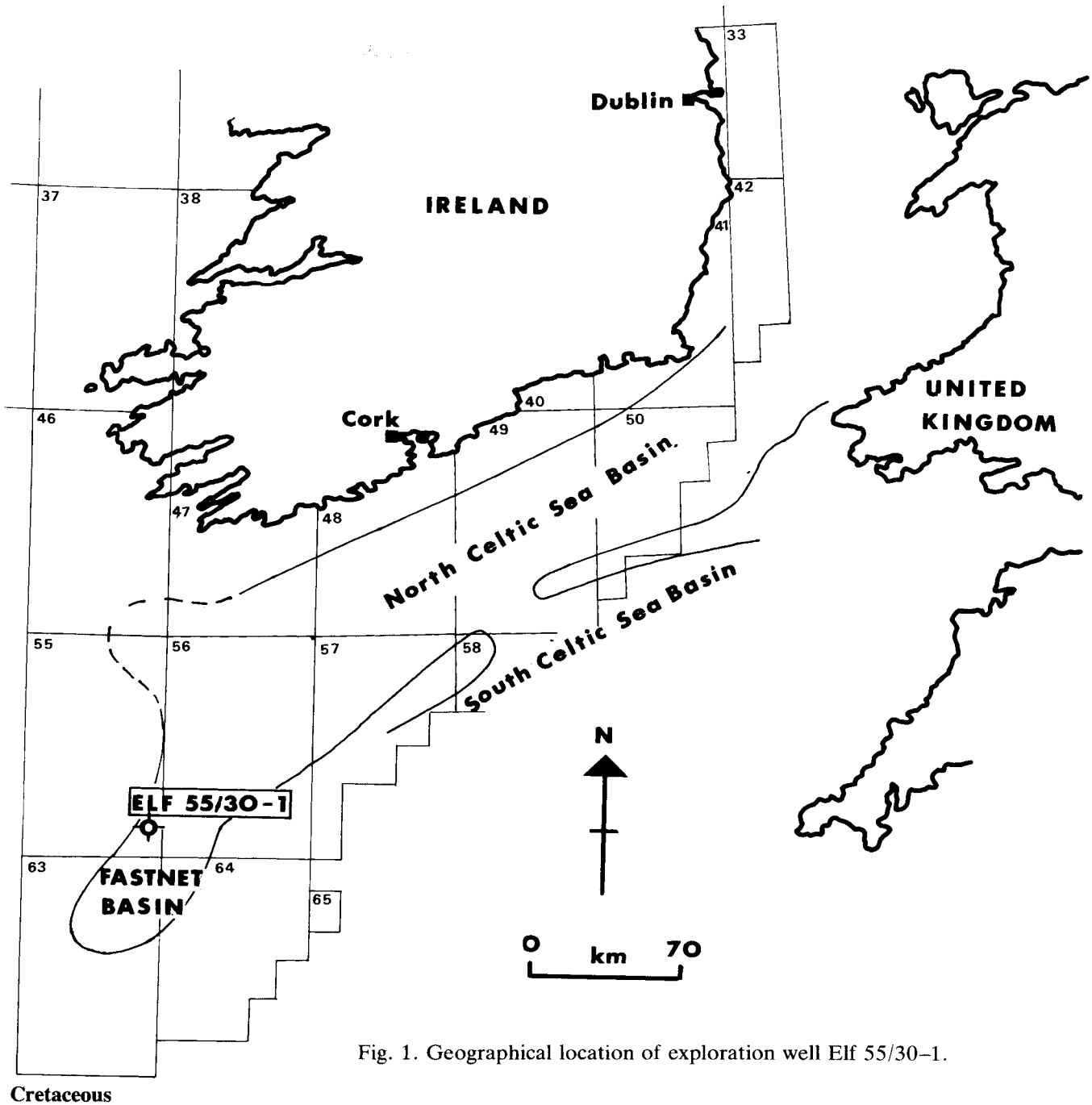


Fig. 1. Geographical location of exploration well Elf 55/30–1.

**Cretaceous**

Early Cenomanian (990m–1020m)

Foraminifera: *Flourensina intermedia* Ten Dam, 1950, *Orbitolina (O.) concava* (Lamark, 1816).

The monospecific *Orbitolina* fauna in the top of the Greensand appears to be from the same form group (equivalent to form group IV of Hofker, 1963, range late Albian to early Cenomanian) as those described from the Upper Greensand of Britain and France which Carter & Hart (1977) have shown to be of early Cenomanian age. This widespread fauna reflects the northward movement of the Tethyan province due to its climatic amelioration and associated transgression in the late Albian and Cenomanian (Price, 1967).

Ostracoda: *Cytherella* sp.

Only fragmental evidence of Ostracoda were seen in the early Cenomanian cuttings.

Albian (1045m–1070m)

Foraminifera: *Citharina gracilis* Marie, 1938, *Conorboides* cf. *C. lamplughi* (Sherlock, 1914), *C. mitra* (Hofker, 1951), *Dorothia subtrochus* Bartenstein, 1962, *D. trochus* (d'Orbigny, 1840), *Gavelinella intermedia* (Berthelin, 1880), *Gavelinella* cf. *G. tormarpensis* Brotzen, 1942, (Berthelin, 1880), *G. symploca* Loeblich

& Tappan, 1949, *Hoeglundina chapmani* (Ten Dam, 1948), *Lagena* cf. *L. sulcata* (Walker & Jacob, 1798), *Lenticulina gaultina* (Berthelin, 1880), *L. subgaultina* Bartenstein, 1962, *Patellina subcretacea* Cushman & Alexander, 1930, *Paalzowella feifeli* (Paazow, 1932), *Tritaxia singularis* Magniez-Jannin, 1973, *Tristix acutangulata* (Reuss, 1863), *Uvigerinammina* cf. *U. moesiana* Neagu, 1965, *Verneuilinoides subfiliformis* Bartenstein, 1952.

No samples were obtained for the 25m interval immediately below the Cenomanian (1020–1045m). It is probably of late Albian age as below it, a rich Middle to early Albian fauna was obtained. The age of the latter was indicated by the presence of *Tritaxia singularis* (Albian), *Verneuilinoides subfiliformis* (Hauterivian to Middle Albian), *Lenticulina subgaultina* (Aptian to Middle Albian) and *Hoeglundina chapmani* (Aptian to Middle Albian), according to the ranges given in the

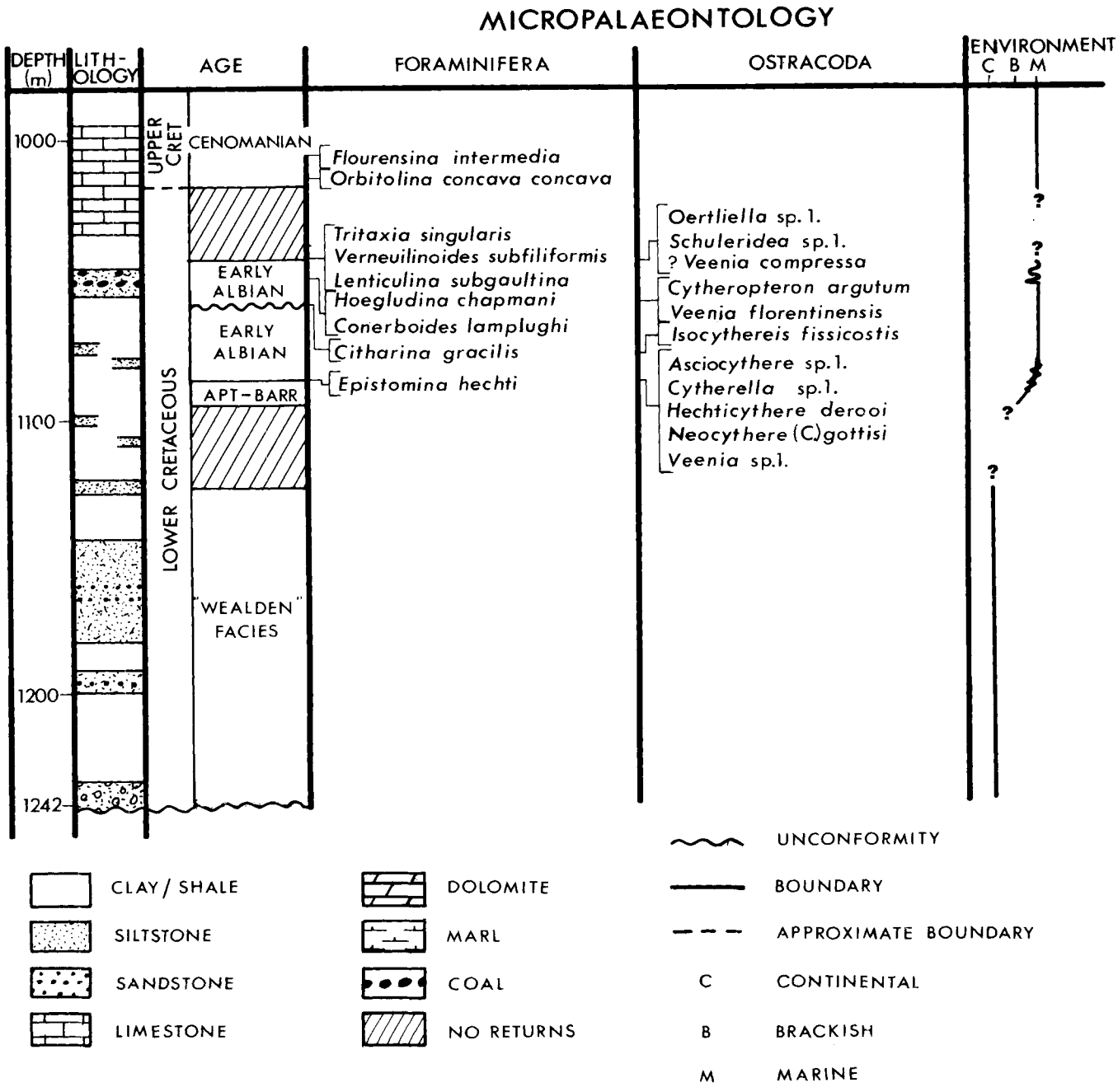


Fig. 2. Biostratigraphical and sedimentological summary of the lowermost Upper Cretaceous and the Lower Cretaceous of exploration well Elf 55/30–1.

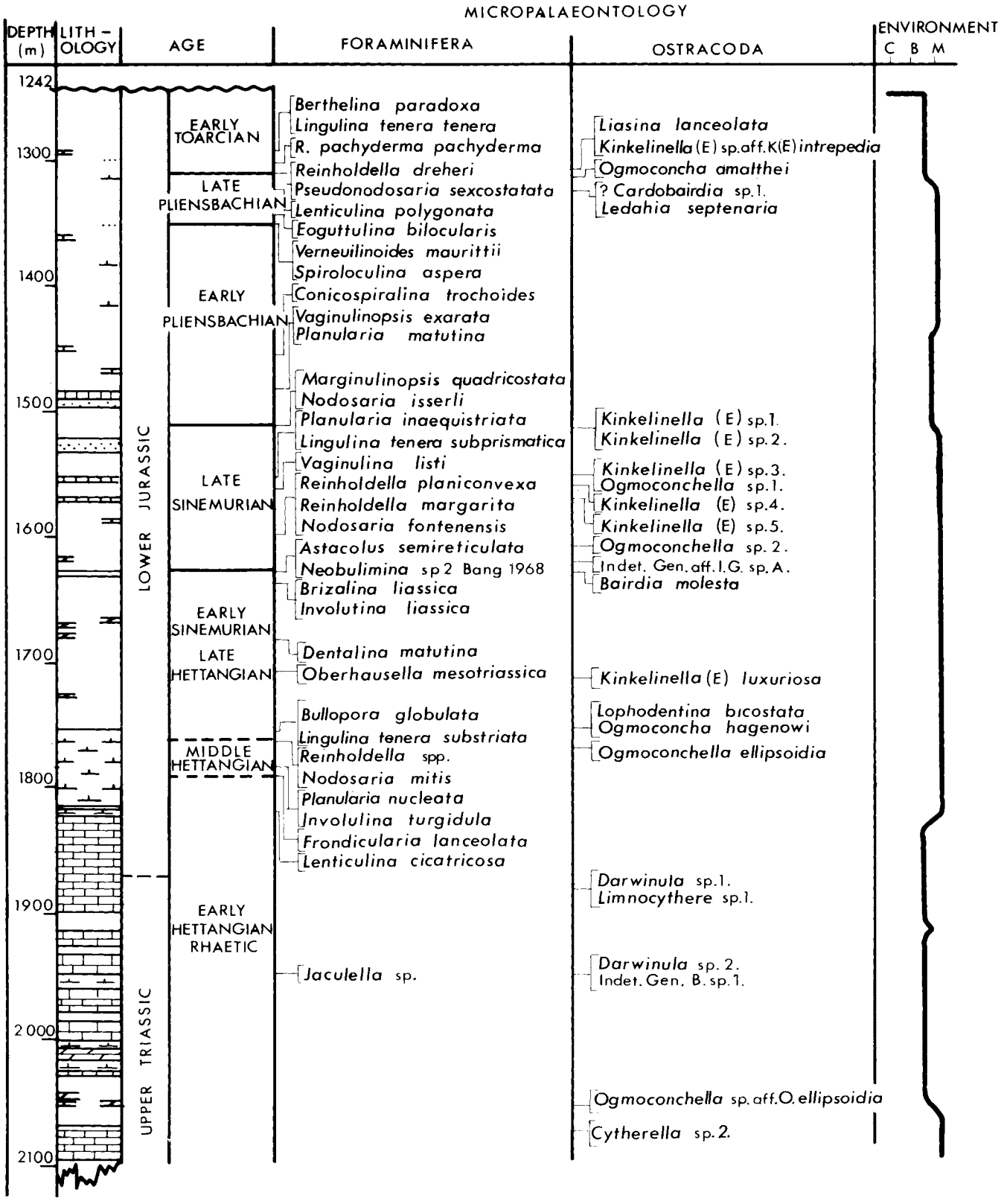


Fig. 3. Biostratigraphical and sedimentological summary of the Lower Jurassic and late Triassic of exploration well 55/30–1.

reviews by Bartenstein (1977, 1979). Some reworking is indicated by the presence of the Jurassic species *Paalzowella feifeli*.

The overall assemblage resembles that described from the early Albian of Rumania by Neagu (1965), and is also similar to the fauna recorded from the Gault Clay of Britain (Chapman, 1891–1898) but is more Tethyan in aspect. The main characteristic of this fauna is the lack of planktonic foraminifera and the moderate diversity. This is probably a reflection of deposition in inner shelf conditions.

Ostracoda: *Bairdoppilata pseudoseptentrionalis* Mertens, 1956, *Cytherella* gr. *C. ovata* (Roemer, 1841) *Cytheropteron argutum* Kaye, 1965, *Eocytheropteron* sp. 1, *Isocythereis fissicostis* Triebel, 1940, *I. fortinodis* Triebel, 1940, *Neocythere* sp. 1, *Oertliella* sp. 1, *Phacorhabdotus bonnemai* (Triebel, 1940), *Rehacythereis* sp. 1, *Schuleridea* sp. 1, *Veenia? compressa* Kaye, 1965b, *V. florentinensis* Damotte, 1961.

Many of these species have been recovered by Colin *et al.* (1981) from the Albian and Cenomanian of the North Celtic Sea. The first definite Albian index species which occurred in this well was *Veenia? compressa* which was recovered immediately below an interval without returns (1020 m–1045 m). This fauna has also been described by Kaye (1965a) in southern England, Germany (Gründel, 1966) and northern France (Damotte, 1971).

Aptian – Barremian (1070 m–1090 m)

The Aptian and Barremian sequences are extremely condensed. As the samples examined were taken only every 10 m, there has been considerable mixing of assemblages, particularly in the sample from 1080–1090 m which contains the Barremian index fossil *Epistomina hechti* with ostracods more typical of the Aptian to late Barremian (see below).

Foraminifera (a) Aptian: *Conorboides* sp., *Vaginulina arguta* Reuss, 1860.

Foraminifera (b) Barremian: *Epistomina hechti*, Bartenstein, Bettenstaedt & Bolli, 1957, *E. sutralis* Ten Dam, 1948, *Lenticulina* cf. *L. nodosa gibba* Espitalie & Signal, 1963, *L. rotulata* Lamark, 1804, *Nodosaria obscura* Reuss, 1863, *Vaginulina arguta* Reuss, 1860.

This fauna resembles those described from England (Crittenden, 1982), France (Damotte & Magniez-Jannin, 1973) and to some extent those of northwest Germany (Hecht, 1938) and the Scotian Shelf (Ascoli, 1976).

Aptian-late Barremian Ostracoda: *Asciocythere* sp. 1, *Centrocythere gottisi* Damotte & Grosdidier, 1963, *Cytherella* sp. 1, *Hechticythere derooi* (Oertli, 1958), *Platella* sp. 1, *Schuleridea* sp. 2, *Veenia* sp. 1.

As mentioned above, due to the considerable mixing of the fauna, many of these species extend downwards into the latest Barremian intervals, however, all of these species do make their first downhole occurrences in the Aptian.

Like the Albian interval, all but *Veenia* sp. 1 and *Platella* sp. 1 have been recorded by Colin *et al.* (1981) from the North Celtic Sea. This associated fauna also shows affinities to that recorded from England (Kaye, 1965b, Kaye & Barker, 1965), southeastern France (Oertli, 1958), northern France (Damotte & Grosdidier, 1963; Damotte, 1971; Damotte & Magniez-Jannin, 1973). Unlike Colin *et al.*, who recovered a "mixed" fauna of characteristic Boreal and Tethyan species, the fauna represented in this well is more typical of the Tethyan Realm.

'Wealden' facies (1090 m–1242 m)

As in the rest of the Fastnet Basin, the sediments of the Wealden facies were devoid of *in situ* microfauna. This contrasts with the Celtic Sea Basin which, in the authors' experience, contains non-marine Ostracoda sufficient to zone the continental section of the Lower Cretaceous and the uppermost Jurassic. The facies in the two basins are similar, and there is no obvious explanation for these differences.

**Lower Jurassic and late Triassic**

Below the barren clays and sandstones of the 'Wealden' facies, there is an abrupt change to the grey shales of the Lias. Much of the following fauna persisted through several stages. This may be partly due to caving, so only the first downhole occurrences and subsequent downhole abundances are mentioned here.

The foraminiferal faunas are similar to those described by Copestake & Johnson (in press) from the Mochras Borehole in North Wales. The zonation given below is based on the ranges of index species established for the Lower Jurassic of Britain (Copestake & Johnson, 1981, 1984) and Europe (Bartenstein & Brand, 1937, Norling, 1972).

Toarcian (1242 m–1320 m)

Foraminifera: *Berthelina paradoxa* Berthelin, 1879, *Falsopalmula deslongchampsi* (Terquem, 1864), *Lenticulina acutiangulata* (Terquem, 1864), *L. varians* subsp. D Barnard, 1950, *Lingulina nodosaria* (Terquem, 1870), *L. tenera tenera* Bornemann, 1854, *Reinholdella pachyderma pachyderma* Hofker, 1952, *Saracenaria sublaevis* (Franke, 1936).

The fauna recovered near to the Toarcian/Pliensbachian boundary was of typical Upper Lias age, with no diagnostic Toarcian forms seen.

Ostracoda: *Kinkelinella (Ektyphocythere) aff. K. (E.) intrepedia* Bate & Coleman, 1975.

The fauna recovered was very sparse, with only a single specimen of the above index microfossil being recorded. The paucity of fauna is probably due to the marginal marine conditions; close proximity to land is indicated by the occurrence of gypsum and lignite within the grey/black shales.

Pliensbachian (1320m–1510m)

(a) Late Pliensbachian: Foraminifera: *Dentalina ventricosa* Franke, 1936, *Eoguttulina liassica* (Strickland, 1846), *Frondicularia brizaeformis* Bornemann, 1854, *F.* sp., *Glandulina vulgata* (Bornemann, 1854), *Haplophragmoides kingensis* Tappan, 1955, *Lenticulina acutiangulata* (Terquem, 1864), *L.* ex gp. *L. muensteri* (Roemer, 1839), *L. polygonata* Frank, 1936, *Marginulina prima prima* d'Orbigny, 1849, *Planularia pseudocrepidula pauperata* Jones & Parker, 1860, *Pseudonodosaria sexcostata* (Bornemann, 1854), *P. vulgata* (Bornemann, 1854), *Reinholdella dreheri* Bartenstein, 1937, *Textularia aeroplecta* Tappan, 1955, *Trochammina* cf. *T. canningensis* Tappan, 1955.

The late Pliensbachian yielded a rich fauna of typical Upper Lias foraminifera which is very similar to that described by Copestake (1974) and Johnson (1975) from the Mochras Borehole and also to that described from the British mainland (Barnard, 1956, 1957, 1959) and northwest Germany (Bartenstein & Brand, 1937).

Ostracoda: *Cardobairdia*? sp., *Ledahia septenaria* (Gründel, 1964), *Liasina lanceolata* (Apostolescu, 1959), *L. vestibulifera* Gramann, 1963, *Ogmoconcha amalthei* (Quenstedt, 1858), Indet. Gen.

The Ostracoda recovered were low both in diversity and abundance compared with the foraminifera in this interval. Many of these species have been recovered by various authors throughout northwest Europe including England (Lord, 1974), the Paris Basin (Apostolescu, 1959), northern Germany (Malz, 1971) and the Danish Embayment (Michelsen, 1975).

(b) Early Pliensbachian: Foraminifera: *Astacolus stillus* Terquem, 1866, *Conicosprillina trochoides* (Berthelin, 1879), *Eoguttulina bilocularis* (Terquem, 1864), *Frondicularia sulcata* Bornemann, 1854, *Glandulina vulgata irregularis* (Franke, 1936), *Lingulina tenera pupoides* (Nørvang, 1957) (=*L. tenera sulcata* (Bornemann, 1854), *L. tenuistriata* (Nørvang, 1957) (=*L. tenera* form 'H' of Barnard), *Marginulinopsis matutina* (d'Orbigny, 1849), *Pseudonodosaria multicostata* (Bornemann, 1854), *P. vulgata irregularis* (Franke, 1936), *Reinholdella dreheri* Bartenstein, 1937, *R. pachyderma pachyderma* Hofker, 1952, *Spirillina trochoides* (Berthelin, 1879), *Spiroloculina aspera* Terquem & Berthelin, 1875, *Vaginulinopsis exarata* (Terquem, 1866), *V.* sp., *Verneuilinoides mauritii* (Terquem, 1866).

The fauna is diverse and numerous at the top and bottom of this interval, but there is a section between 1400m–1450m, in which microfossils are rare or absent. This appears to correspond with the sparse foraminiferal faunas encountered in the early Pliensbachian of Britain (Copestake & Johnson, 1981). Sedimentation in this interval consists of dark grey shales with pyrite suggesting basin stagnation with anoxic bottom conditions.

Ostracoda: *Bairdia* aff. *B. carinata* Drexler, 1958, *Isobythocypris* aff. *I. elongata* (Tate & Blake, 1876), *Pseudomacrocypris* sp. 1, Indet. Gen.

As with the foraminifera, this interval yielded a sparse assemblage, with noticeably few new downhole occurrences.

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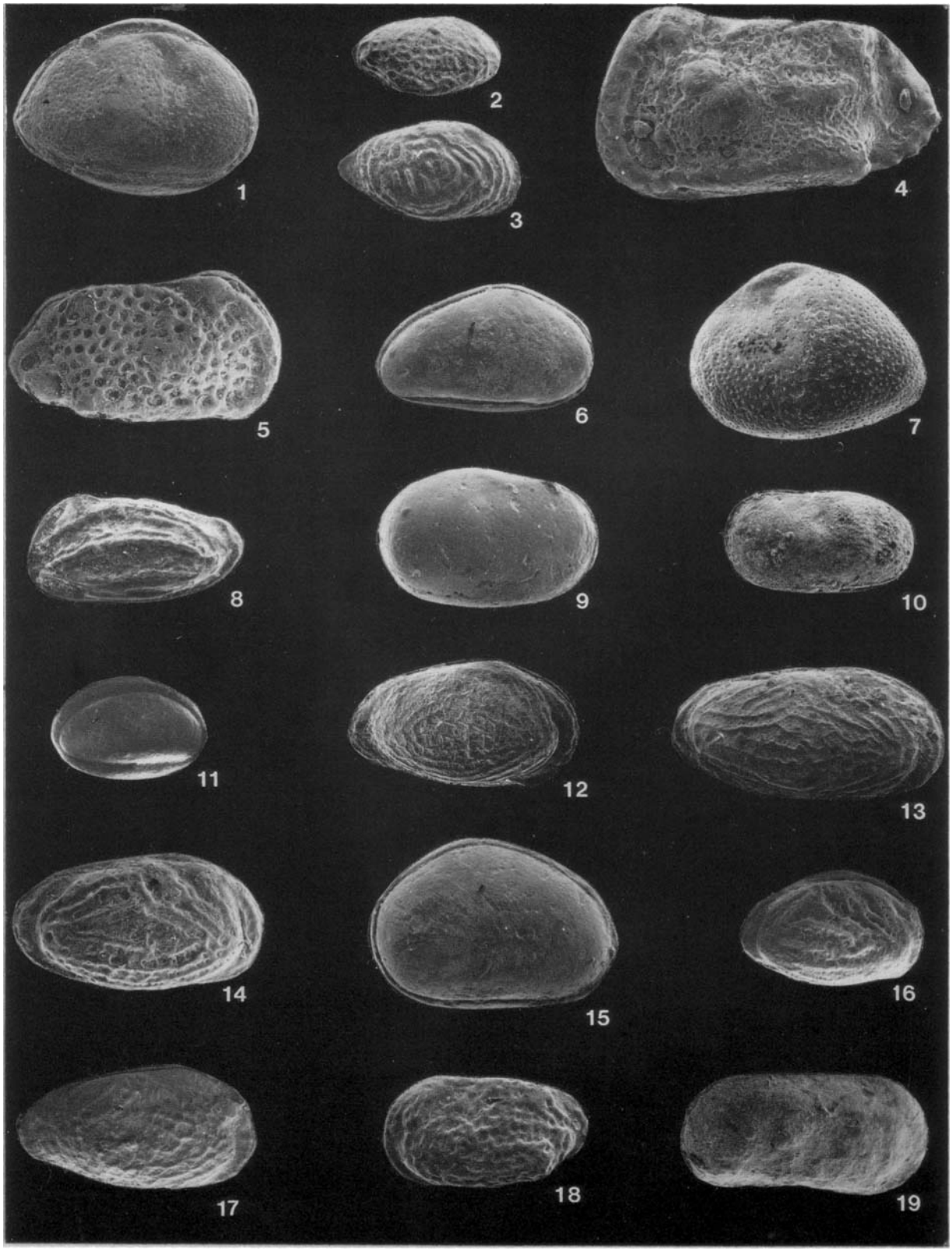
**Explanation of Plate 1**

Fig. 1. *Schuleridea* sp. 1, right view, ×60, 1045m, Albian.
Fig. 2. *Cytheropteron (Eocytheropteron)* sp. 1, right view, ×60, 1050m, Albian.
Fig. 3. *Neocythere (Neocythere)* sp. 1, right view, ×60, 1060m, Albian.
Fig. 4. *Rehacythereis* sp. 1, left view, ×60, 1055m, Albian.
Fig. 5. *Oertliella* sp. 1, right view, ×60, 1070m, Albian.
Fig. 6. *Asciocythere* sp. 1, right view, ×60, 1080m, Aptian – late Barremian.
Fig. 7. *Schuleridia* sp. 2, left view, ×60, 1080m, Aptian – late Barremian.
Fig. 8. *Veenia* sp.1, left view, ×60, 1080m, Aptian – late Barremian.
Fig. 9. *Cytherella sp. cf. C. pyriformis* (Cornuel, 1846), right view, ×60, 1080m, Aptian – late Barremian.
Fig. 10. *Platella* sp. 1, left view, ×60, 1080m, Aptian – late Barremian.
Fig. 11. *?Cardobairdia* sp. 1, right view, ×60, 1330m, late Pliensbachian.
Fig. 12. *Kinkelinella (Ektyphocythere)* sp. 1, right view, ×60, 1520m, late Sinemurian.
Fig. 13. *Kinkelinella (Ektyphocythere)* sp. 2, right view, ×60, 1530m, late Sinemurian.
Fig. 14. *Kinkelinella (Ektyphocythere)* sp. 3, right view, ×60, 1550m, late Sinemurian.
Fig. 15. *Ogmoconchella* sp. 1, right view, ×50 1550m, late Sinemurian.
Fig. 16. *Kinkelinella (Ektyphocythere)* sp. 4, right view, ×60, 1610m, Sinemurian.
Fig. 17. *Kinkelinella (Ektyphocythere)* sp. 5, right view, ×60, 1610m, Sinemurian.
Fig. 18. Indet. Gen. aff. Gen. Indet. sp. A, Lord, 1974, left view, ×60, 1630m, early Sinemurian.
Fig. 19. *Limnocythere* sp. 1, right view, ×60, 2045m, Rhaetic – early Hettangian.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Sinemurian – late Hettangian (1510m–1760m)

(a) Late Sinemurian: Foraminifera: *Dentalina gladiiformis* Franke, 1936, *D. ventricosa* Franke, 1936, *Frondicularia terquemi sulcata* Bornemann, 1854, *Lenticulina gottingensis* (Bornemann, 1854), *L. varians varians* Bornemann, 1854, *L. varians recta* Franke, 1936. *L. varians suturalis-costata* Franke, 1936, *Lingulina tenera pupoides* Nørvang, 1957, *L. tenera subprismatica* Nørvang, 1957, *Marginulina prima praerugosa* Nørvang, 1957, *Marginulinopsis prima* (d'Orbigny, 1849), *M. quadricosta* (Terquem, 1863), *M. radiata* Franke, 1936, *M. vetusta* (d'Orbigny, 1849), *Nodosaria dispar* Frank, 1936, *N. fontinensis* (Terquem, 1863), *N. isserli* Franke, 1936, *Planularia inequistriata* (Terquem, 1863), *Reinholdella margarita* (Terquem, 1863), *R? planiconvexa* (Fuchs, 1970), *Saracenaria* aff. *S. segmenta* Tappan, 1955, *S.* sp., *Vaginulina listi* (Bornemann, 1854).

It should be noted that the range of *Planularia inequistriata* in this well is the same as in France (Bizon, 1961, Bizon & Oertli, 1961), rather than the shorter range encountered in the Mochras Borehole by Copestake & Johnson (1981).

Conversely, *Reinholdella margarita* only ranges up to the early Sinemurian in Britain (Copestake & Johnson, 1981) and its first downhole occurrence at 1600m may therefore represent the top of the early Sinemurian. However, its range in France extends into the late Sinemurian and until its range for this area is better established, it cannot be used as an early Sinemurian marker.

The fauna is abundant and diverse and includes a variety of long ranging species not mentioned above, such as *Eoguttulina* spp. and *Lenticulina* spp. ex gp. *L. muensteri*.

Ostracoda: *Kinkelinella* spp., *Ogmoconchella* sp. 1, *Ogmoconchella* sp. 2, *Paracypris* sp., Indet. Gen.

While abundance is low through this interval there is moderate diversity, with numerous new taxa. These include undescribed species of *Kinkelinella (Ektyphocythere)* and some undescribed genera. Many specimens of *Kinkelinella* recovered from 55/30–1 show marked similarity to *K. (E.) treibeli* (Klinger & Neuweiler, 1959) recorded from the late Sinemurian of northern Europe.

(b) Early Sinemurian – late Hettangian (1630m–1760m): Foraminifera: *Astacolus minuta* Bornemann, 1854, *A. semireticulata (Fuchs, 1970)*, *Bullopora globata* Barnard, 1949, *Dentalina matutina* d'Orbigny, 1849, *Involutina liassica* (Jones, 1853), *Marginulina lamellosa* Terquem & Berthelin, 1875, *M.* cf. *M. radiata* Terquem, 1864, *Neobulimina* sp. 2, Bang, 1969, *Nodosaria mitis* Terquem & Berthelin, 1875, *Oberhausella mesotriassica* (Fuchs, 1970), *Lingulina tenera substriata* Nørvang, 1957, *Vaginulina listi* (Bornemann, 1854).

These species together provided a zone approximately coinciding with the early Sinemurian in the Mochras Borehole (Copestake, 1975).

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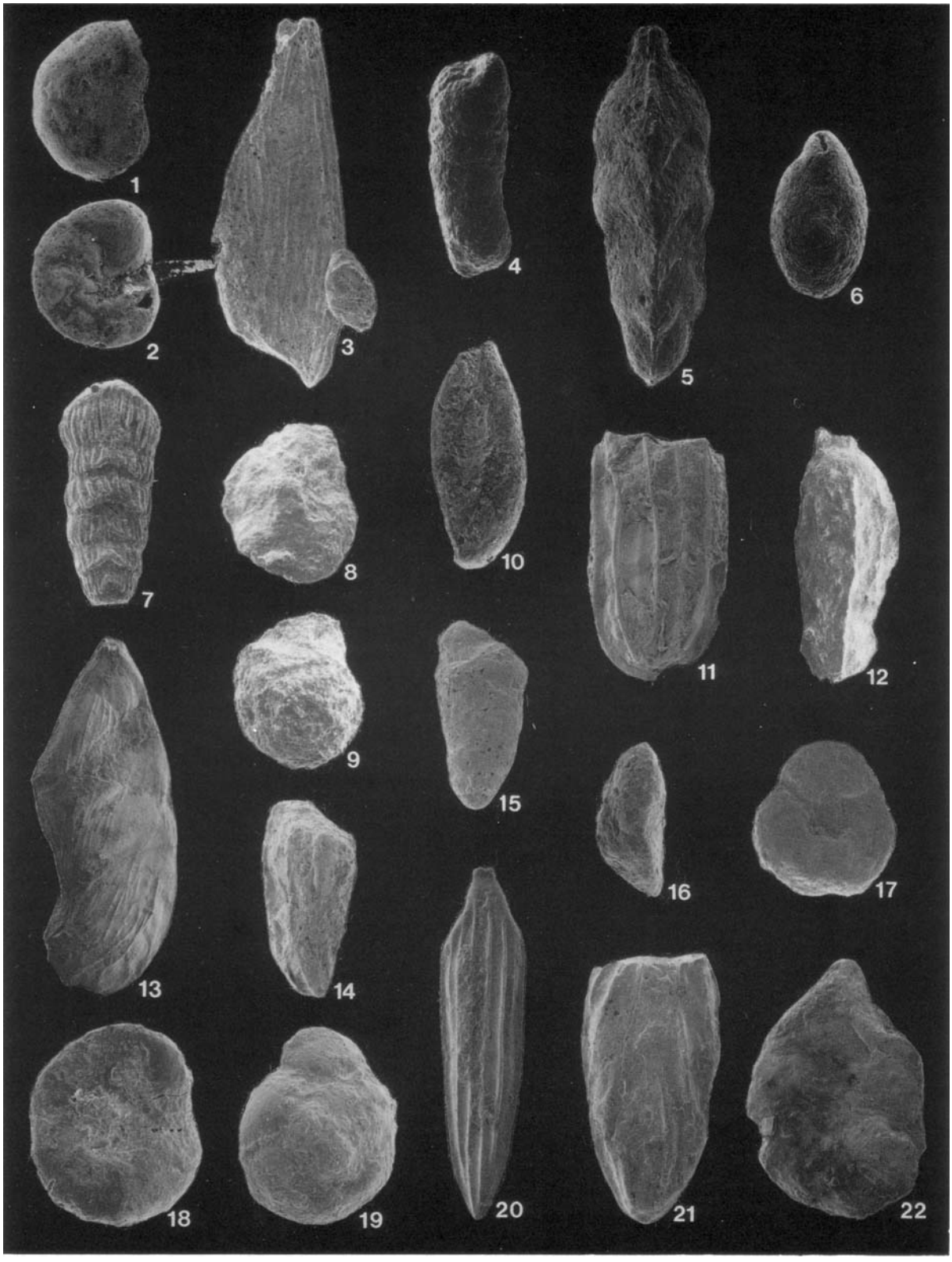
**Explanation of Plate 2**

Fig. 1. *Gavelinella* cf. *G. tormarpensis*, dorsal view, × 110, 1045m, Albian.
Fig. 2. *G.* cf. *G. tormarpensis*, ventral view, × 110, 1045m, Albian.
Fig. 3. *Citharina gracilis*, side view, × 85, 1060m, Albian.
Fig. 4. *Verneuilinoides subfiliformis*, side view, × 100, 1045m, Albian.
Fig. 5. *Tristix acutangulata*, side view, × 110, 1050m, Albian.
Fig. 6. *Uvigerinammina* cf. *U. moesiana*, side view, × 135, 1050m, Albian.
Fig. 7. *Lingulina nodosaria*, side view, 1290m, × 110, Toarcian.
Fig. 8. *Reinholdella macfadyenii*, dorsal view, × 100, 1320m, Pliensbachian.
Fig. 9. *R. macfadyenii*, ventral view, 1320m, × 100, Pliensbachian.
Fig. 10. *Spriroloculina aspera*, 1350m, × 160, Pliensbachian.
Fig. 11. *Vaginulinopsis exarata*, 1510m, × 110, early Pliensbachian.
Fig. 12. *Marginulina prima*, side view of variant, 1480m, × 100, early Pliensbachian.
Fig. 13. *Saracenaria* aff. *S. segmenta*, side view, 1520m, × 75, late Sinemurian.
Fig. 14. *Marginulina hamus*, side view, 1600m, × 100, late Sinemurian.
Fig. 15. *Neobulimina* sp. 2, cf. Bang, 1968, side view, 1640m, × 110, early Sinemurian.
Fig. 16. *Reinholdella planiconvexa*, side view, 1720m, × 110, early Sinemurian to late Hettangian.
Fig. 17. *R. planiconvexa*, ventral view, 1760m, × 110, early Sinemurian to late Hettangian.
Fig. 18. *Reinholdella pachyderma* pachyderma, ventral view, × 110, 1760m, Hettangian.
Fig. 19. *Reinholdella pachyderma pachyderma*, dorsal view, × 110, 1760m, Hettangian.
Fig. 20. *Frondicularia lanceolata*, side view, × 100, 1790m, Hettangian.
Fig. 21. *Lingulina tenera substriata*, side view, × 135, Hettangian.
Fig. 22. *Lenticulina citcatricosa*, side view, × 110, 1800m, Hettangian.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Ostracoda: *Bairdia molesta* Apostolescu, 1959, *Isobythocypris* cf. *I. elongata* (Tate & Blake, 1876), *Lophodentina bicostata* (Drexler, 1958), *Kinkelinella (Ektyphocythere) luxuriosa* (Apostolescu, 1959), *K. (E.)* sp., *Ogmoconcha hagenowi* Drexler, 1958, numerous Indet. Gen.

The uppermost intervals of this section contained the most diverse fauna, with the abundance decreasing downwards towards Hettangian strata.

Unlike the late Sinemurian, most of the species occurring at this level have been previously recorded elsewhere in Europe.

Middle Hettangian – Rhaetian (1760m–2100m)

(a) Middle Hettangian: Foraminifera: *Involutina turgidula Kristan*, 1957, *Lenticulina varians convulutus* (Bornemann, 1854), *Marginulina prima burgandiae* Terquem, 1864, *Nodosaria mitis* Terquem & Berthelin, 1875, *Oberhausella mesotriassica* (Fuchs, 1970), *Planularia nucleata* Terquem, 1863, *Reinholdella margarita* Terquem, 1866, *R. ?planiconvexa* (Fuchs, 1970).

The top of this interval is marked by the flood occurrence of the *Reinholdella* spp. and *Oberhausella mesotriassica*. A similar flood is reported from the Middle Hettangian (liasicus zone) in the Mochras Borehole (Copestake & Johnson, 1981) and it is probable that the two are equivalent. Their age is supported by the occurrence of *Planularia nucleata* which was recorded from the Hettangian (Barnard, 1949) in his study of the Lower Lias of Byfield although its total range is uncertain.

Ostracoda: *Ogmoconchella ellipsoidea* (Jones, 1872).

(b) Early Hettangian – Rhaetian: Foraminifera: *Frondicularia lanceolata* Banner, 1971, *Lenticulina citatricosa* Fuchs, 1970, *Lingulina tenera tenera*, *Nodosaria nitidana* Brand, 1937.

The early Hettangian age of the upper part of this interval is indicated by *Frondicularia lanceolata*, supported by the occurrence of *Lenticulina citatricosa* which was first recorded from the lowermost Lias of Austria.

Below 1820m, the fauna is extremely sparse with occasional incursions of a fauna of a broadly Lower Lias aspect and few simple agglutinated species at 1930m.

Ostracoda: *Cytherella* sp. 2, *Darwinula* sp. 1, *D.* sp. 2, *Limnocythere* sp. 1, *Ogmoconcha hagenowi* Drexler, 1958, *Ogmoconchella ellipsoidea* Jones, 1872, *O.* aff. *O. ellipsoidea* Jones, 1872, and Indet. Gen.

Both *Ogmoconcha hagenowi* and *Ogmoconchella ellipsoidea* were recovered in flood abundance between the intervals 1800–1810m, however, both these species abruptly disappeared below 1820m (the top of the limestone). No microfauna was recorded until 1880m where a new fauna occurred, consisting mainly of *Darwinula* spp. and *Limnocythere* sp., often in abundance, indicating brackish environments (Kozur & Oravecz-Schoffer, 1972). Although many species of *Limnocythere* recorded in Europe occur within the Rhaetic, the present authors' species may range into the earliest Hettangian.

Below this non-marine fauna, between 2045–2080m, a marine ostracod fauna was recovered, consisting of abundant *Ogmoconchella* aff. *O. ellipsoidea* from a clay interval. The presence of this fauna within the otherwise non-marine limestones indicates an unstable marginal environment at the commencement of the Rhaetian marine transgression (Robinson *et al.*, 1981, Naylor & Shannon, 1982). This fauna disappeared after 2080m and below this no microfaunas were recovered.

## CONCLUSIONS

The marginal marine and marine sediments encountered in Elf 55/30–1 contained microfaunas which were used to provide a good biostratigraphical and palaeoecological zonation of the Lower Cretaceous, the Lower Jurassic and part of the late Triassic. The non-marine 'Wealden' interval could not be subdivided due to the absence of *in situ* faunas.

The facies and microfaunas occurring in this well were closely comparable with those seen in the Mesozoic of Great Britain and France, although ranges of some of the microfossils are different.

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